Pamphlet accompanies map

GEOLOGIC MAP OF NEWBERRY VOLCANO, DESCHUTES, KLAMATH, AND LAKE COUNTIES, OREGON

By

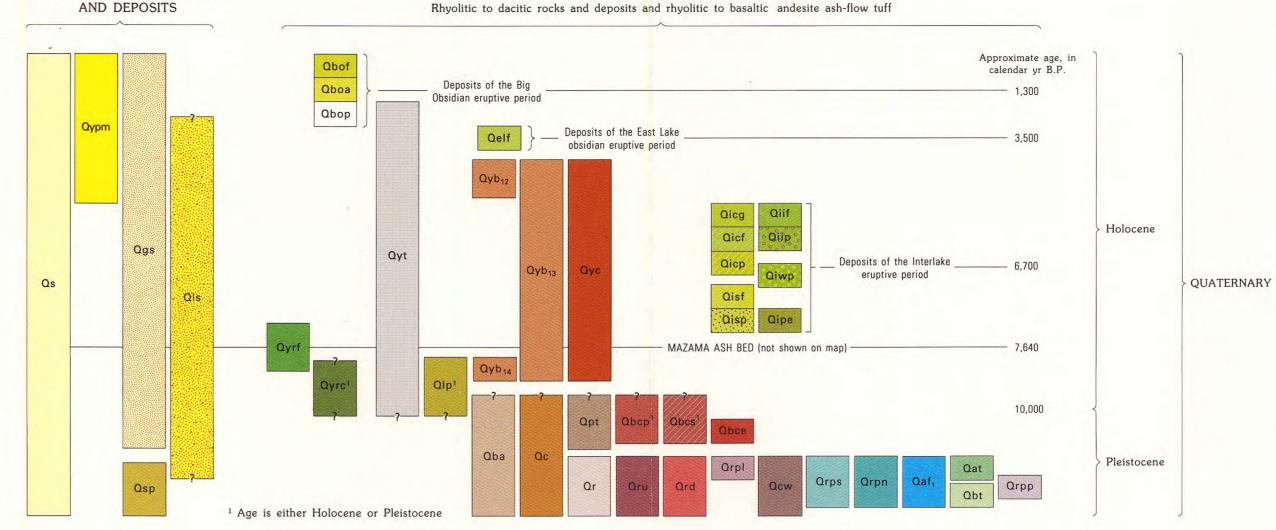
Norman S. MacLeod, David R. Sherrod, Lawrence

A. Chitwood, and Robert A. Jensen

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CORRELATION OF MAP UNITS

VOLCANIC ROCKS AND DEPOSITS



DESCRIPTION OF MAP UNITS

[Units listed only with name are described more completely on sheet 1]

CHIEFLY SEDIMENTARY ROCKS AND DEPOSITS

CHIEFLY SEDIMENTARY ROCKS

Sedimentary deposits (Holocene and Pleistocene)

Oypm Young pumiceous mudflow deposits (Holocene)

Ogs. Gravel and sand of the caldera (Holocene and Pleistocene)

Sedimentary and pyroclastic deposits (Pleistocene)

Qis Landslide deposits (Holocene and Pleistocene?)

VOLCANIC ROCKS AND DEPOSITS

[The first 18 map units of young eruptive products are mostly younger than the Mazama ash bed. Rhyolite is abundant in and near the caldera; basalt and basaltic andesite become increasingly abundant away from the caldera on the volcano flanks, where young rhyolitic rocks are lacking. Representative chemical analyses are listed on table 5]

Deposits of the Big Obsidian eruptive period—Divided into:

Big Obsidian Flow (Holocene)—Nearly aphyric rhyolitic glass. Chemically homogeneous, as shown by 91 analyses (Laidley and McKay, 1971); SiO₂ is about 72.8 percent. Contains inclusions of more mafic rock interpreted as mixed magma by Linneman (1990). Age about 1,300 ¹⁴C yr B.P. on basis of ¹⁴C age of related underlying pyroclastic-flow unit (Qboa) and hydration-rind age of obsidian. Youngest volcanic unit on Newberry volcano; part of an eruptive sequence that began with pumiceous tephra showers (Qbop) followed by ash flows (Qboa) and terminating with the Big Obsidian Flow. Vent for all three units shown by "x" near south end of Big Obsidian Flow, where small protrusion rises above general flow surface. A northeastern lobe of the flow buried an older unrelated vent, shown by dotted "x." Irregular black dots show size and shape of explosion craters on surface of flow. Beneath some of these craters are large spherical chambers as large as 15 m in diameter and interpreted as the source of the crater-forming explosions (Jensen, 1993)

Ash-flow deposits of Paulina Lake (Holocene)—Unconsolidated, poorly sorted, pinkish-brown rhyolitic pumiceous ash, lapilli, and blocks south of Paulina Lake. Unit includes ash-cloud deposits northeast of Big Obsidian Flow (Qbof) and near-vent deposits southwest of it. Bedded sand and ash along shore of Paulina Lake may result from interaction of hot pyroclastic flow with lake waters. Three analyses: 72.4, 73.1, and 73.4 percent SiO₂. Age about 1,300 ¹⁴C yr B.P. (table 1; Libby's [1952] age is too old); derived from same vent as Big Obsidian Flow. Second youngest volcanic unit on Newberry volcano

Pumice-fall deposits (Holocene)—Distribution is shown only by isopachs. Well-sorted, angular, light-gray rhyolitic pumice lapilli, fewer lithic fragments, and minor ash. Forms one fall unit on lower east flank but grades upslope into a thick fall overlain by several thin fall deposits on upper flank and in caldera. Unit contains breadcrusted accidental lithic and juvenile obsidian blocks as much as 1 m in diameter within 2 km of vent. Contains about 72.8 percent SiO₂ (average of five analyses with very little range). Derived from same vent as Big Obsidian Flow (Qbof) (Friedman, 1977; Sherrod and MacLeod, 1979). Probably only slightly older than ash-flow deposits of Paulina Lake (Qboa), but pumice-fall deposits have age of about 1,600 ¹⁴C yr B.P. (table 1) and therefore may be as much as 300 yrs older. Third youngest volcanic unit on Newberry volcano

Young rhyolitic tephra (Holocene and Pleistocene?)—Thick tephra deposits that completely bury older units over large areas of caldera and upper flanks. Those near-vent deposits with well-defined physiographic form, such as Central Pumice Cone (Qicp), are mapped separately. Unit contains (1) pumice deposits younger than Mazama ash bed and derived from vents in the caldera; (2) Mazama ash bed, which was derived from caldera-forming eruptions at Crater Lake; and (3) pumice deposits older than Mazama ash bed and probably derived from vents in caldera. Deposits younger than Mazama ash bed locally include thickest parts of pumice-fall deposits (Qbop) of the Big Obsidian eruptive period (distribution shown by isopachs) and East Lake tephra deposit of MacLeod and others (1982). East Lake tephra deposit, a widespread ash deposit that covers most of east side of caldera and upper east flank of volcano, typically comprises a lower 3 m of unbedded, poorly sorted pumiceous ash, lapilli, and blocks and an upper 1-2 m of bedded pumiceous ash and lapilli with mud-armored pumice lapilli. It probably resulted from phreatomagmatic eruptions at unknown vent(s) in eastern part of caldera, perhaps beneath East Lake as interpreted from bathymetry (vent symbol shown dotted); mean age is 6,400±130 ¹⁴C yr B.P. (table 1) and SiO₂ content is 71.9 percent (one analysis). Not shown are pre-Mazama pumiceous tephra deposits found at several localities along west rim of caldera and on Paulina Peak dome because their distribution is too poorly known

Deposits of the East Lake obsidian eruptive period—Consists of:

East Lake obsidian flows (Holocene)—Informally named unit. Hydrationrind age is 3,500 yr B.P. (table 2). Erupted from vents near inner caldera
ring fault; pumiceous tephra from same vents are found within 1 km of the
flows and are included as part of young rhyolitic tephra (Qyt). Five chemical analyses: range is 71.5 to 73.9 percent SiO₂. Probably fourth youngest volcanic unit on volcano; older than deposits of the Big Obsidian eruptive
period (Qbof, Qboa, Qbop)

Young basaltic andesite (Holocene)—See sheet 1 for more complete descriptions and for other parts of this eruptive sequence. Units shown on sheet 2 are:

North Summit Flow

The Dome flow—Informally named unit

Devils Horn flow—Informally named unit

Young cinder-cone and fissure-vent deposits (Holocene)

Deposits of the Interlake eruptive period—Several rhyolitic lava flows and near-vent deposits, representing the first major post-Mazama eruptions within

the caldera. Includes two well-known volcanic features, the Central Pumice Cone and the Interlake Obsidian Flow. Conceivably the caldera contained a single large lake until eruptive products of the Interlake eruptive period formed a barrier across center of caldera. Divided into:

Central Pumice Cone and related deposits (Holocene)—Divided into: Game Hut Obsidian Flow—Three analyses: 73.1, 73.3, and 73.7 percent SiO₂. Hydration-rind age is 6,700 yrs B.P. (table 2); younger than Central Pumice Cone. May formerly have been connected to crater-filling obsidian flow (Qicf)

Crater-filling obsidian flow—Probably represents remnants of a lava lake that ponded in the Central Pumice Cone (Qicp). Three analyses: 73.3, 73.5, and 74.0 percent SiO₂. Hydration-rind age of 4,500 yr B.P. from flow is probably too young, in view of hydration-rind age of 6,700 yr B.P. from Central Pumice Cone itself (table 2)

Central Pumice Cone—Present between Paulina and East Lakes. Chiefly

pumiceous to dense (obsidian) lapilli and ash. Includes massive and agglutinated obsidian plastered on crater wall midway from the top, which may represent "bathtub-ring" remnant of a former lava lake. (Game Hut Obsidian Flow [Qicg] may have been produced by draining of lava lake, and the crater-filling obsidian flow [Qicf] may be a remnant of lake.) Three analyses from pumiceous bombs range from 72.7 to 74.0 percent SiO₂. Hydration-rind age of obsidian clasts in cone is 6,700 yr B.P. (table 2)

Interlake Obsidian Flow and related deposits (Holocene)—Divided into:

Interlake Obsidian Flow—Five chemical analyses: range is 72.6 to 74.0 percent SiO₂. Hydration-rind age is 6,700 yrs B.P. (table 2). Related pumiceous tephra ramparts (Qiip) surround vent at base of north caldera wall. Irregular black dots show size and shape of explosion craters on surface of flow. Younger than Central Pumice Cone (Qicp)

flow. Younger than Central Pumice Cone (Qicp)

Pumice-ring deposits—Pumice deposits that mark vent at north end of

Pumice Cone at Warm Springs Campground (Holocene)—Pumice cone complex at Warm Springs Campground on northeast side of Paulina Lake. Older than Interlake Obsidian Flow (Qiif). Not associated with extrusion of obsidian flow

Obsidian flow—Small pumiceous obsidian flow in pumice ring east of Big Obsidian Flow (Qbof). One analysis: 72.8 percent SiO₂ (Linneman, 1990). Undated; Mazama ash bed not found on surface, but poorly exposed flow is thickly covered by pumice-fall deposits (Qbop) of the Big Obsidian eruptive period and may be older than Mazama ash bed

Pumice-ring deposit—Elongate small pumice ring along inner south wall. Filled by obsidian flow (Qisf). Overlain by young rhyolitic tephra (Qyt); probably younger than Mazama ash bed

Pumice-ring deposits south of East Lake (Holocene)—Pumice ring near

caldera wall south of East Lake. Overlain by young rhyolitic tephra (Qyt); probably younger than Mazama ash bed

[The following eruptive products are older than the Mazama ash bed. They are diverse in

Young rhyolite of the upper southeast flank (Holocene)—Three small domes and associated pumice-ring(?) deposits. Contains about 73.9 percent SiO₂ (two analyses). Thickly mantled by pumice-fall deposits (Qbop) of the Big Obsidian eruptive period; may be older than Mazama ash bed but none was seen upon it. Chemically similar to rhyolitic rocks younger than Mazama ash bed and to young rhyolite dome and flow of the caldera (Qyrc), all of which are chemically distinct from older rhyolites

Young rhyolitic dome and flow of the caldera (Holocene or Pleistocene)—
Dome is near inner caldera wall south of East Lake. Associated obsidian flow, which extends northward to East Lake, is labeled parenthetically and its outline shown dotted owing to burial by Mazama ash bed and 4-5 m of pumiceous tephra (Qyt). Unit contains about 72.9 percent SiO₂ (three analyses)

Pumice-ring deposits of Lost Lake (Holocene or Pleistocene)—Ash, lapilli, and blocks that form pumice ring partly filled by north end of Big Obsidian Flow (Qbof). Probably Holocene, but may be of latest Pleistocene age

Basaltic andesite (Holocene? and Pleistocene)

Cinder-cone and fissure-vent deposits (Holocene? and Pleistocene)—
Ash, lapilli, blocks, bombs, and agglutinated spatter that form vent deposits related to basaltic andesite, basalt, andesite, and locally dacite in units Qba and Qbc (sheet 1)

Palagonite tuff (Holocene? and Pleistocene)—Palagonitized, formerly glassy basaltic lapilli tuff. Forms (1) tuff cone of Little Crater at southeast side of Paulina Lake; (2) scattered outcrops on south side of East Lake—probably a vent complex, most of which is buried by young rhyolitic tephra (Qyt); and (3) palagonite tuff erupted from an unknown vent and now found plastered on north caldera wall above Interlake Obsidian Flow (Qiif). Age is chiefly Pleistocene, but tuff cone of Little Crater may be Holocene

Basaltic andesite of the caldera (Holocene? and Pleistocene)—Three lava flows, all of which are overlain by Mazama ash bed and young rhyolitic tephra (Qyt). Divided into:

Basaltic andesite of Paulina Lake (Holocene or Pleistocene)—Lava along east shore of Paulina Lake. Four analyses range from 52.6 to 54.3 percent SiO₂. Older than adjacent gravel and sand of the caldera (Qgs). Vent presumably is buried by Central Pumice Cone (Qicp)

Basaltic andesite of Sheeps Rump (Holocene or Pleistocene)—Lava that issued from Sheeps Rump cinder cone northeast of East Lake and extends nearly to lake shore. Its steep, leveed margin protrudes through blanketing young rhyolitic tephra and Mazama ash bed, giving the flow a dikelike appearance

from east rim fissure near top of caldera wall and flowed northwest nearly to East Lake. Highly variable phenocryst content and chemical composition; it and east rim fissure (mapped as part of unit Qc) range from 55.5 to 63.7 percent SiO₂ and may be products of mixed magma. Age is 10,970±500 calendar yr B.P. (14C age of 10,500±500 yr B.P., table 1) or very latest Pleistocene. Equivalent to (informal) Resort and East Lake andesite flows of Higgins (1973)

Rhyolitic obsidian flows (Pleistocene)—Two flows: at top of south caldera wall east of Paulina Peak and on northeast side of East Lake. Slightly porphyritic, with plagioclase and scant hypersthene. Both flows are mostly buried by tephra deposits and cut by caldera ring faults. They are indistinguishable from each other in their major-oxide and trace-element composition and phenocryst characteristics, suggesting probable comagmatic relation. Flow east of Paulina Peak has one analysis: 72.5 percent SiO₂. Flow northeast of East Lake has three analyses: 71.3, 72.1, and 72.3 percent SiO₂

Rhyolite, rhyodacite, and dacite lava flows and domes, undivided (Pleistocene)—Lava petrographically similar to other silicic domes and flows on flanks, but not chemically analyzed. Some domes are mapped on basis of very sparse outcrops combined with geomorphic expression. Two probable domes on upper east flank (southeast of East Lake) are mostly buried by pumice-fall deposits (Qbop) of the Big Obsidian eruptive period, young rhyolitic tephra (Qyt), and Mazama ash bed. Labeled parenthetically for rhyolite flow buried by young rhyolitic tephra (Qyt) in caldera

Rhyodacite domes and flows (Pleistocene)

Rhyodacite of Paulina Lake (Pleistocene)—Two domes on southwest shore of Paulina Lake. Unit contains 70.3 percent SiO₂ (one analysis). Potassium-argon ages are 0.56±0.40 and 0.58±0.40 million years (table 3, Nos. 15 and 16), but unit is likely younger than rhyodacite of Paulina Peak (Qrpp). Pattern indicates associated pumice-ring deposits preserved only on southeast side of unit

Rocks of the caldera walls (Pleistocene)—Platy rhyolite lava flows, basalt and basaltic andesite lava flows and breccia, tuff, ash-flow tuff, welded airfall tuff, and palagonite tuff. (See sheet 1 for complete description)

Rhyodacite pumice deposit of the southwest flank (Pleistocene)

Orpn Rhyodacite pumice deposit of the northeast flank (Pleistocene)

shown on sheet 2 is:

Tuff southeast of Paulina Peak

Qat Andesitic tuff (Pleistocene)

Rhyodacite of Paulina Peak (Pleistocene)—Large, elongate dome of Paulina Peak and two small domes west and southwest of it. Unit contains about 71.4 percent SiO₂ (average of nine analyses with little variation). Paulina Peak dome has K-Ar ages of 0.58±0.40 and 0.24±0.07 million years (table

Ash-flow tuff (Pleistocene)—See sheet 1 for more complete descriptions. Unit

3, Nos. 19 and 20)

Obt Basaltic andesite lapilli tuff (Pleistocene)

Contact—Approximately located or inferred; dotted where concealed. Units completely buried by young rhyolitic tephra (Qyt) are labeled parenthetically
 Contact within unit—Separates adjacent cinder cones in unit Qc

—— Margin of individual lava flows in unit Qba—Shown only where flow fronts are sufficiently steep and distinct for at least 0.5 km; interpreted in part from aerial photographs. Less obvious flow contacts, particularly of older flows, are not shown

•••••• Caldera ring fault—Ring faults are entirely concealed and are inferred from topographic evidence

Bathymetric contours—In Paulina and East Lakes; datum is mean lake level, contour interval is 40 ft (from unpub. data, Oregon Department of Wildlife). Supplementary contour at 20-ft interval shown dashed in southwest corner of East Lake, the area interpreted as vent for East Lake tephra deposit Thickness of pumice-fall deposits (Obop) of the Big Obsidian eruptive

Isopach—Showing thickness in centimeters. Contour interval 25 cm for thicknesses to 200 cm, and a single 300-cm line. Unit not mapped separately: where thickest, it is mapped as young rhyolitic tephra (Qyt), as in caldera and on upper flanks of volcano; elsewhere, underlying rocks and deposits are depicted,

and unit is distinguished only by isopachs

Measurement locality—Showing thickness in centimeters

Holocene silicic vents—Vent locations for Holocene silicic lava flows, pyroclastic flows, and air-fall tephra units erupted in caldera and on upper southeast flank of volcano. Dotted where buried by younger deposits or flooded (floor of East Lake)

Craters on obsidian flows—Showing size and shape. Craters pock parts of the surfaces on Interlake Obsidian Flow (Qiif) and Big Obsidian Flow (Qbof)

Geothermal well in caldera or on volcano flanks—See table 4 for spe-

cific well locations and total depth drilled

Analyzed rock sample—Showing location and letter for chemical analysis (table 5) and (or) sample number for K-Ar age determination (table 3)

Thermal features in caldera

Hot springs—Northeast shore of Paulina Lake and southeast shore of East

Hot springs—Northeast shore of Paulina Lake and southeast shore of East Lake
 Fumarole—In crater of pumice ring along northeast lobe of Big Obsidian Flow

_____ Trail

Caldera access road